

situation changes in the future, it is expected that the gas cells and other optical path difference scanners disclosed here may be replaced with the corresponding electro-optic components. Figure 15 shows a suitable gas cell arrangement with a piston for changing the pressures in the two cells.

It is thought that there are several gases which are appropriate for use in optical path difference scanner by pressure change. Xenon is attractive because it is completely inert and has a high refractive index which means that the pressure need not be changed as much to effect the same difference in path. It is thought that pressure changes of approximately 100 atmospheres with a path length through the gas of an inch would be useful. If the path through the gas is longer, then the pressure change can be reduced. Nitrogen is also an attractive gas for opd scanning because it is inexpensive and inert. The two gas cells in Figure 15 are connected such that amount of gas in either cell may be varied by actuating the piston. The two gas cells have suitable windows so that the beams may pass through unobstructed. By varying the pressure through the actuator mechanism, the optical path of an interferometer may be scanned. This approach is known for small path differences. The utility of it here is that the opd must be scanned without introducing any tilt or shear in the beams.

Figure 16 shows an arrangement with a roof reflector supported by an air bearing and driven by a solenoid coil. The precision of the air bearing is required in this case because the optical alignment is not completely compensated as it is in the other components, or when scanning with the gas cell arrangement. For clarity, Figure 16 does not show two roof reflectors. The second would be placed behind the first and is generally indicated by the dotted line. One is used for each of the beams for which optical path is to be scanned. This optical arrangement called "optical path difference scanner" can be inserted at several points in the beam path. There are several types of optical path difference scanners that can be used with the basic interferometers of Figures 11, 12, 13, and 14. Unfortunately, the refractive scanners of the nutating disk type cannot be used because they cause a shift in the beam. In the interferometer of Figure 1, the shift is undone by a second pass through the disk in the reverse direction. In a four-port interferometer, the beam cannot go back on itself because it would lead to degeneracy in the ports - that is, it would be a two-port interferometer.

Other suitable path difference scanners can be constructed using combinations of mechanically stable components such as air bearing drives, cube corner reflectors and roof reflectors. Numerous other methods for scanning the opd without introducing tilt or shear may be combined with the devices disclosed herein.

The principles, embodiments and modes of operation of the present inventions have been set forth in the foregoing provisional specification. The embodiments disclosed herein should be interpreted as illustrating the present invention and not as restricting it. The foregoing disclosure is not intended to limit the range available to a person of ordinary skill in the art in any way, but rather to expand the range in ways not previously considered. Numerous variations and changes can be made to the foregoing illustrative embodiments without departing from the scope and spirit of the present inventions.

#### **What is Claimed is:**

1. A spectrometer, comprising:  
  
a source of a primary beam of radiant energy;

a beamsplitter fixed in relation to the primary beam, for dividing primary beam into at least first and second energy beams which follow first and second optical paths;

a tunable solid-state reference laser coupled to the spectrometer through a filter;

at least one return reflector for reflecting the first beam back to the beamsplitter;

at least one radiant energy detector;

a control, data acquisition and processing electronic system;

2. A spectrometer, comprising:

a source of a primary beam of radiant energy;

a beamsplitter fixed in relation to the primary beam, for dividing primary beam into at least first and second energy beams which follow first and second optical paths;

at least one return reflector for reflecting the first beam back to the beamsplitting means;

at least one radiant energy detector;

a control, data acquisition and processing electronic system;

a roof reflector rigidly coupled to the beamsplitter for the purpose of folding the second beam by an angle;

3. A spectrometer, comprising:

a source of a primary beam of radiant energy;

a beamsplitter fixed in relation to the primary beam, for dividing primary beam into at least first and second energy beams which follow first and second optical paths;

at least one return reflector for reflecting the first beam back to the beamsplitting means;

at least one radiant energy detector;

a control, data acquisition and processing electronic system;

at least one flat compensator plate, having parallel faces, which may be scanned by nutation to vary the optical path difference;

4. the spectrometer of claim 1 where the filter is an etalon;

5. the spectrometer of claim 1 where the solid-state laser is a vertical cavity surface emitting laser;

6. the spectrometer of claim 1 where the solid state laser has a

linewidth of less than 1 cm-1;

7. the roof reflector assembly of claim 2 where the assembly is machined by wire EDM;
8. the roof reflector assembly of claim 2 where the assembly is fabricated from ceramic;
9. the roof reflector assembly of claim 2 where the reflective coating is prepared by replication;
10. the spectrometer of claim 3 where a second refractive scanning plate is interposed in the first or second beam;
11. the spectrometer of claim 1 where the signal generated by the diode laser is demodulated;
12. the spectrometer of claim 1 where an additional source of radiant energy is used to probe the transfer functions of the detector or detectors;
13. the spectrometer of claim 1 where the transfer function of the detector is inverted by the use of an adaptive filter;
14. the spectrometer of claim 1 where the radiation detector detects an optically subtracted beam;
15. the spectrometer of claim 1 where the detector signal is modified to correct for nonlinear response using the response to a probe signal;
16. the spectrometer of claim 2 where the detector signal is modified to correct for nonlinear response using the response to a probe signal;
17. the spectrometer of claim 3 where the detector signal is modified to correct for nonlinear response using the response to a probe signal.